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Comprehensive Support and Student Success: Can Out of School Time Make a Difference?

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Comprehensive Support and Student Success: Can Out of School Time Make a Difference?

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Abstract

StudentU is a comprehensive program that provides education, nutrition, and social support services to disadvantaged students outside of the regular school day. In this paper I investigate the effects of this multi-year program on the early high school outcomes of participating students by exploiting data from oversubscribed admissions lotteries. I estimate that lottery winners who entered the comprehensive program with low baseline achievement earned more course credits (0.82 credits), achieved higher grade point averages (0.37 grade points), and were less likely to be suspended (17.1 percentage points) during ninth grade than their lottery loser counterparts. Investigation of candidate channels indicates that increased student effort and improved behavior in school are likely mechanisms. Using an index of early high school outcomes, I predict that lottery winners are around 4 percentage points more likely to graduate from high school than lottery losers (5 percent effect). These results suggest that comprehensive services delivered outside of the regular school day have the potential to improve the educational outcomes of disadvantaged students.

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1 Introduction

Gaps in skills between children born into low- versus high-income families exist at all levels of K-12 schooling in the United States (U.S.). In some cases, these gaps appear prior to kindergarten entry and then widen as students progress through the K-12 system (Duncan and Magnuson, 2011; Farkas, 2011; Reardon, 2011). Long-studied policy interventions designed to ameliorate income-based skill gaps frequently take aim at the existing K-12 system. These include school resource policies, input policies (e.g., class size, innovative curricula, and high-quality teachers), and other market-based reforms (e.g., charter schools, voucher programs). In contrast, much less attention has been devoted to understanding the effects of interventions that target another point of intervention: time spent outside of school. Structured activities and services provided outside of the regular school day are increasingly the focus of public investment in the U.S., but little is known about their effects on student outcomes. Figure 1 depicts appropriations between 1995 and 2018 for the main federal program that serves children outside of the regular school day in the U.S. Despite a nearly one thousand-fold increase in real federal support for this program over the past two decades, very little is known about how time spent outside of school affects student success.

Existing research literature that addresses time spent and services provided outside of school typically focuses on specialized interventions that narrowly target specific skill domains or areas of student need among disadvantaged students. Examples of specialized interventions that target specific skills include academic tutoring (Heinrich et al., 2010; Zimmer et al., 2010; Heinrich et al., 2014), advising, coaching, and mentoring (Grossman and Tierney, 1998; Angrist et al., 2009; Bettinger and Baker, 2014; Castleman et al., 2014), and behavioral supports (Heller et al., 2013; Cook et al., 2014; Heller et al., 2017). Related interventions address specific areas of student need, such as nutrition, although these interventions are typically carried out within the regular school day (Bhattacharya et al., 2006; Imberman and Kugler, 2014; Corcoran et al., 2016).

In contrast, much less is known about the effects of interventions that take a broader view and provide comprehensive education, nutrition, and social support services outside of the regular school day on the outcomes of disadvantaged students. Two existing papers in the literature attempt to address this question, although they do so imperfectly because the programs tested in each paper paired the provision of comprehensive services with generous financial incentives, which have been shown to have strong independent effects on student outcomes, such as achievement and high school graduation, in some other contexts (Leuven et al., 2010; Ford and Kwakye, 2016). Oreopoulos et al. (2017) report quasi-experimental evidence on the effects of the Pathways to Education program, a comprehensive, out-of-school program for public housing residents in Toronto, Canada. They report that access to Pathways for the duration of high school increased graduation rates by between 5-15 percentage points and postsecondary enrollment by between 4-19 percentage points. In related work, Rodríguez-Planas (2012) reports results from a multi-site randomized controlled trial of the Quantum Opportunity Program (QOP), which provided comprehensive services outside of the regular school day to low-achieving high school students. She also finds that the offer of comprehensive services increased high school graduation rates, at least in the short-run. However, she finds some evidence to suggest that the control group eventually caught up and graduated high school at rates similar to their treated counterparts.

In this paper, I address this gap in the literature by producing causal evidence on the effects of comprehensive education, nutrition, and support services provided outside of the regular school day on the early high school outcomes of disadvantaged students. I study this question in the context of StudentU, a non-profit organization in Durham, North Carolina that provides these services through a multi-year program that takes advantage of students' time outside of school after school during the academic year and during summer breaks. To produce evidence on the causal effects of this program, I leverage data from oversubscribed admissions lotteries carried out to allocate slots in the program. By comparing lottery winners and losers, I produce internally valid estimates of the effect of access to comprehensive

services on the outcomes of disadvantaged students. I take advantage of the multi-year structure of the program to estimate impacts on student outcomes in the medium-term. Specifically, I examine impacts on credit accumulation, grade point average, and suspension as broad measures of how the program affects students' cognitive and noncognitive skills in early high school.

On average, StudentU lottery winners accumulated more credits and were less likely to be suspended in early high school than their lottery loser counterparts. However, I find strong evidence to suggest that these mean impacts were exclusively driven by lottery winners who entered the program with low levels of baseline achievement. My investigation of treatment effect heterogeneity along this dimension yields substantial evidence to suggest that effects in the full sample of lottery winners were driven by this subgroup of students with low baseline achievement. I further find that this subgroup of students achieved higher grade point averages by the end of ninth grade. Specifically, lottery winners with low baseline achievement accumulated 0.82 more course credits, achieved higher grade point averages (GPAs) by 0.37 grade points, and were 17.1 percentage points less likely to be suspended during ninth grade.

By the end of ninth grade, StudentU lottery winners who entered the program with low baseline achievement had outcomes that were similar to – or even superior to – their control group counterparts who entered the program with high baseline achievement. To contextualize these results, students in the high baseline achievement group entered the program with an average math and reading score of 0.38 SDs (median = 0.26 SDs) relative to the statewide mean of zero (and unit standard deviation). In contrast, students in the low baseline achievement group entered the program with an average math and reading score of -0.90 SDs (median = -0.80 SDs). These findings suggest that comprehensive services provided outside of the regular school may be a particularly effective strategy for improving outcomes of the most disadvantaged students.

To provide evidence on the mechanisms underlying these effects I leverage data on inter-

vening variables to help to distinguish candidate channels of student effort, achievement, and behavior in school. By exploiting data on credits attempted, course failure, achievement test scores (in eighth grade), and reported disciplinary infractions, I assess the relative contributions of these channels. I find evidence most consistent with increased student effort and improved behavior in school as primary channels. Coupled with the findings on for whom comprehensive services work, these results about mechanisms provide policy-relevant insight into how comprehensive services work to improve student outcomes.

I conclude by presenting the results from back-of-the-envelope calculations designed to investigate how the effects of StudentU on early high school outcomes likely translate into longer-term effects on in high school graduation. Using an index of early high school outcomes and data on past cohorts of first-time ninth grade students, I predict that lottery winners are around 4 percentage points more likely to graduate from high school than lottery losers. There results are on the low end of the range of estimated effects on high school graduation reported by the previous literature but are still consistent with previous findings about comprehensive programs delivered outside of school. I conclude with a brief discussion of program costs.

This paper contributes to the growing research literature on the effects of comprehensive services provided outside of the regular school day on student outcomes and builds on this previous work by providing evidence from a setting uncontaminated by the addition of financial incentives for participation. This paper is the first, to my knowledge, to use a randomized lottery design to produce causal evidence on this question. The results from this paper provide new, policy-relevant insight into the role that non-profit and other organizations can play in shaping the outcomes of disadvantaged students outside of the regular school day. They provide new evidence on a point of intervention – time outside of the regular school day – that has remained largely unexplored in the existing literature that considers how to reduce achievement gaps by family income and other forms of educational inequality.

2 Background

2.1 StudentU's Mission

StudentU is a 501(c)(3) non-profit organization that provides education, nutrition, and related social support services outside of the regular school day to disadvantaged students in Durham, North Carolina. These services include academic programming, healthy meals and snacks, parent/caregiver outreach, coaching, advising, and, mentoring, and referrals for children and families to other community services. These comprehensive services are delivered through intensive after school programming that takes place outside of the regular school day during the academic year and summer programming that occurs between academic years. StudentU's core values are: Energize Your Community, Achieve Greatness, Respect Yourself and Others, Discover Your Best Self, Dream Fearlessly, and Share Your Brilliance. These core values influence the activities of the organization and motivate the organization's mission, which is, "[T]o empower students in the Durham Public Schools to own their education by developing the academic skills and personal well-being necessary to succeed in college and beyond."[1]

StudentU students are drawn from traditional public schools in Durham Public Schools (DPS), charter schools, and independent (private) schools located within the Durham County, North Carolina. Students enter the program as rising sixth graders – the summer before middle school begins – and remain in the program until high school graduation. Students in the program participate after school (called "School Year Program") and during the summer (called "Summer Academy"). The School Year Program takes place a central location on regular attendance days during the academic year. Summer Academy occurs for six weeks during the summer.

StudentU selected its first cohort of students during the spring of semester of the 2006/07

[1]Despite the reference to Durham Public Schools (DPS) in the mission statement, StudentU is also open to students who attend charter schools and independent (private) schools in Durham County.

academic year and has selected a new cohort of students in the spring of every academic year since then. Students are eligible to apply for admission to StudentU in the fall of fifth grade and then receive notice of their admissions decision in the spring of 5th grade. Students formally matriculate into the program during the summer prior to middle school entry (sixth grade). Beginning in the 2011/12 school year, StudentU received applications in excess of its capacity and decided to use lotteries to determine admission to the program. Upon acceptance into the program, StudentU students and their families sign contracts and agree to participate in program activities over the subsequent seven-year period. There are no direct costs for students or their families to participate, and transportation is provided for students to attend both the School Year Program and Summer Academy.

Due to the intensity and scope of the comprehensive services provided, StudentU is intentionally small – there are 50 students in each cohort. All students who submit a complete application, which includes short essay questions and a teacher recommendation, are screened against two criteria prior to the lottery: students must be the first person in their immediate family to attend college and/or eligible for free/reduced price lunch. All completed applications that satisfy at least one of these two criteria are entered into that year's admissions lottery. In practice, there are often fewer than 50 slots available each year, since StudentU has historically granted automatic admission to siblings who have an older sibling already enrolled in the program.

2.2 StudentU Programming

Following acceptance into StudentU, rising sixth grade students attend Summer Academy, an intensive six-week program designed to strengthen students' academic credentials through small-group instruction and to promote students' development through elective courses and activities designed to enhance socio-emotional learning. During Summer Academy, which meets from 8AM-4PM five days per week for six weeks, students attend daily, 50-minute classes in Math, Science, English Language Arts (ELA), and Global Connect (Social Studies).

These small-group classes are led by trained local college students (typically those pursuing a baccalaureate degree in education) or certified teachers from surrounding local school districts who work for StudentU during the summer. In addition to these required courses, students also develop their personal interests by choosing elective course offerings (e.g., poetry, the arts, or astronomy). Finally, outside of these core and elective courses, StudentU also promotes physical and emotional health through participation in exercise-based activities and wellness classes. Each day also includes one hour of "Family Time," during which students meet with a regular group of peers and an adult mentor (typically a teacher or other staff member in the program). Family Time is split into three short sessions dispersed throughout the day, thus providing students with regular and sustained adult and peer support throughout the program.

Following Summer Academy, StudentU students participate in 15 hours per week of after school programming each week for 30 weeks during the school year. After school programming includes tutoring and supervised homework time ("Study Skills"), while also allowing students to participate in extracurricular activities ranging from athletics to the arts. Students also participate in structured academic activities outside of their school work each day ("Academic Power Hour"), which are led by program staff and designed to strengthen students' reading, math, and writing skills. To facilitate the provision of these services, StudentU has 20 full-time employees, including a social worker, a bilingual parent-liaison, and an education specialist. In addition to these full-time staff, additional tutors, mentors, and summer teachers are hired from surrounding universities and local school districts.

2.3 Previous Work

Comprehensive programs designed to address multiple areas of skill development or student need may be particularly effective at improving educational outcomes among disadvantaged students because they provide students with access to a suite of services that have been shown to be effective at improving student outcomes in other settings. These include, for example,

academic support and nutrition assistance (i.e., access to healthy meals and snacks), which I discuss in turn below. Above and beyond these services, which target skill development and specific areas of need, comprehensive programs also provide support to students in ways that resemble interventions designed to provide coaching, advising, and mentoring. This aspect of comprehensive programs may better allow students to take full advantage of the other services in the program by providing positive relationships, encouragement, and additional assistance when needed. In their analysis of the successes of the Pathways program for public housing residents in Toronto, Oreopoulos et al. (2017) cite qualitative evidence from staff interviews and quantitative evidence from meditation analysis to emphasize the importance of these supportive relationships in facilitating the successes of comprehensive programs.

Much of the previous work on the effects of academic support and instruction provided outside of the regular school day finds that traditional tutoring programs – when delivered in isolation – are ineffective at raising student achievement. Using quasi-experimental variation induced by the introduction of supplemental education services (SES) (i.e., tutoring) in school districts under No Child Left Behind (NCLB), several recent papers investigate the effects of tutoring on student achievement. Heinrich et al. (2010) report results from the introduction of SES in Milwaukee Public Schools. They do not find any statistically significant effects on student math or reading gains. In related work, Heinrich et al. (2014) report the results of a multi-site investigation of the same type of services provided to low-income students in four large school districts in the U.S. Although they find some evidence of positive math and reading gains in one district, they do not find consistent evidence of positive effects on achievement in any of the other three. In contrast, in a study of SES in Pittsburgh Public Schools, Zimmer et al. (2010) report some evidence of positive test score gains in math and identify differentiated instruction by student skill level, emphasis on knowledge gaps from previous coursework, and tutor experience as key factors affecting success. Emerging from these papers and the prior literature is the consensus that factors such as tutor quality, intensity, group size, program management, and differentiated instruction

are important determinants of whether tutoring programs are successful. In more recent work that incorporates these insights, Ander et al. (2016) report the results from several randomized controlled trials of intensive "tutorials" (two-on-one tutoring carried out within the regular school day) on the achievement of low-income students. These tutorials, which provide highly individualized instruction to struggling students on a daily basis, have been shown to increase math test scores by 0.23 standard deviations and reduce the incidence of math course failure by as much as 50 percent.

The evidence on the effects of nutrition assistance on student outcomes is more mixed, with some papers reporting positive effects and others reporting null results. In early evaluation of the School Breakfast Program (SBP), Bhattacharya et al. (2006) report improvements in nutrition outcomes among students exposed to the program. These included improvements in outcomes like vitamin and mineral intake and decreases in the poor diet outcomes (e.g., the percent of calories obtained from fat). In work investigating the effects of Breakfast in the Classroom (BIC), Imberman and Kugler (2014) report evidence of positive effects on student test scores. By exploiting variation in the timing of BIC introduction, the authors conclude that the likely source of these test score gains is improvements in test performance and not necessarily changes in student learning. In related work, Corcoran et al. (2016) examine the introduction of BIC across schools in New York City, although in this study the authors find no evidence of improvements in student test scores.

Existing literature on the effects of intensive coaching, advising, and mentoring largely comes from interventions designed to improve educational outcomes for students transitioning from high school to postsecondary or from programs for students in the early years of their postsecondary careers. Although the contexts of these interventions are varied, papers in this literature provide insight into the mechanisms that underlie the successes of these interventions. In a study investigating the effects of intensive coaching and mentoring on students' college application behavior and subsequent enrollment, Carrell and Sacerdote (2017) examine how coaching and mentoring can improve student outcomes when students

face intricate and multi-faceted challenges that extend over long time horizons (e.g., the college application process). They argue that intensive coaching and mentoring is likely a substitute for the sustained efforts of a parent, teacher, or other support person. Evidence from Bettinger and Baker (2014) provides further insight into the ways in which intensive coaching and mentoring can help students connect their habits, activities, and behaviors to their goals. The authors hypothesize that coaches, advisors, and mentors help students concretely develop strategies and implement action plans in service of their abstract goals. In a randomized controlled trial of coaching for nontraditional college students, the authors find that students exposed to the offer of regular coaching had improved persistence outcomes in a variety of postsecondary settings. Coaching and mentoring effects on student outcomes appear even when the services are provided in small doses. Castleman et al. (2014) find that access to a single 2-3 hour sessions for students transitioning from high school to college improves student enrollment outcomes. In related work, Clotfelter et al. (2018) find that in addition to generous financial aid, nonfinancial supports (e.g., mentoring and social support) improved on-time credit accumulation and grade point averages among low-income, first-generation college students at a large, selective public university.

3 Data

The data in this paper come from two sources: (1) StudentU application and lottery records and (2) administrative education data from the North Carolina Education Research Data Center (NCERDC) covering the universe of students enrolled in public and charter schools in North Carolina.

3.1 Matching StudentU Applications to NCERDC Data

All StudentU application and lottery records were matched to existing NCERDC administrative data based on the student's first name, last name, date of birth, and elementary school

attended in 5th grade.[2] The matching procedure carried out by NCERDC staff yielded an overall match rate of 86 percent and was similar to the match rate obtained in other studies that have utilized the same NCERDC data.[3]

StudentU started using admissions lotteries in the spring of 2012, resulting in three separate lottery-based cohorts from the years 2012, 2013, 2014, respectively. Appendix Table A1 summarizes the results from the NCERDC matching procedure. After excluding younger siblings who were granted automatic admission to StudentU outside of the lottery process, 324 out of 376 student applications were matched to records in the NCERDC system. A match rate of 100 percent was not expected, since some students who attend independent schools (private and religious) in Durham County participate in StudentU. These students are not included in the administrative data at NCERDC and therefore could not be matched. The overall match rate was 92 percent for lottery winners and 84 percent for lottery losers, although the pattern of obtaining a higher match rate among lottery winners was not consistent across cohorts.

3.2 Student-Level Data from NCERDC

Administrative data containing information on student characteristics and outcomes came from the North Carolina Education Research Data Center (NCERDC). These data are provided to NCERDC from the North Carolina Department of Public Instruction (DPI) and cover the universe of students enrolled in public and charter schools in North Carolina.

The administrative NCERDC data provided baseline student characteristics and post-lottery outcomes. Time-invariant demographics included student gender and race/ethnicity, as well as the following characteristics measured at baseline prior to the lottery (5th grade):

[2]Per Institutional Review Board (IRB) mandate, StudentU application and lottery records were sent directly from StudentU to staff at the North Carolina Education Research Data Center (NCERDC), who handled the process of matching the identifiable student-level information contained in lottery records to the administrative student-level data. The matched data were then de-identified and transferred from NCERDC to the author for analysis.

[3]See Gassman-Pines and Bellows (2018) for a brief overview and discussion of match rates obtained in previous studies that have utilized the NCERDC data.

eligibility for free/reduced price lunch, age, special education status, gifted designation, Limited English Proficiency (LEP) status, and math and reading test scores.

Post-lottery outcomes in early high school included measures constructed from student transcripts and summary measures constructed from the universe of reported disciplinary infractions and their associated consequences (e.g., suspensions). Outcomes constructed from raw transcript data included the number of course credits earned by the end of ninth grade and grade point average.[4] Summary measures constructed from the universe of reported disciplinary infractions included the following binary indicators: any suspension in ninth grade, any violent or weapons-related disciplinary infraction, and any other disciplinary infraction.[5]

3.3 Descriptive Statistics

To explore patterns of selection into the StudentU applicant pool, Table 1 presents descriptive statistics for fifth grade students enrolled in traditional public and charter elementary schools in Durham County, North Carolina and StudentU applicants. Column (1) reports summary statistics for all fifth grade students in Durham County, while Column (4) presents summary statistics for the subset of fifth grade students who were eligible for free- or reduced-price lunch (FRL-eligible). The subset of students who are FRL-eligible approximates the population of students in Durham County who are eligible to apply for StudentU, although the approximation is imperfect due to the fact that StudentU requires applicants to be either FRL-eligible or a first-generation college student (not both). The administrative data do not provide information on parental education or first generation college status, so this restriction based on FRL-eligibility is the closest approximation that can be implemented in the administrative data. Column (7) presents summary statistics for StudentU applicants

[4] I constructed a weighted version of student grade point average using letter grades and course designations (e.g., Honors, Advanced Placement, etc.) to ensure that GPA was measured consistently across schools. For more detail on this measure, see Appendix B.

[5] Broadly speaking, the category of all other disciplinary infractions included drug-related, disruptive, sexual, and miscellaneous offenses. For a sample list of infractions, see Appendix B.

from the 2012, 2013, and 2014 cohorts.

Aside from documenting differences between the StudentU applicant pool and other students in Durham County, I provide further context of the educational setting in Durham County by documenting differences between the traditional public and charter sectors. Columns (2) and (3) partition the population of fifth graders in Durham County into those who attend Durham Public Schools and charter schools, respectively. Columns (5) and (6) partition the population of FRL-eligible fifth graders in Durham County into the same two subgroups. Comparisons of mean characteristics between the traditional public and charter sectors confirm previously documented differences.[6] On average, the charter sector contains lower shares of students who are Hispanic, gifted, Limited English Proficient, and FRL-eligible, and a larger share of students who are white. Students attending charter schools also have lower reading achievement on average.

StudentU applicants differ on observables from other public and charter students in Durham County. Columns (8) presents differences in means and associated standard errors for StudentU applicants versus all other fifth grade students in Durham County, conditional on lottery-fixed effects and lottery fixed-effects interacted with gender. Relative to all other fifth grade students in Durham County, StudentU applicants are more likely to be female (9.1 pp), Hispanic (20.3 pp), Limited English Proficient (4.5 pp), and FRL-eligible (22.5 pp), and they are less likely to be white (18.7 pp).

Column (9) presents differences in means for StudentU applicants and all FRL-eligible fifth grade students in Durham County. StudentU applicants differ on observables from the population of FRL-eligible students in Durham County. Relative to FRL-eligible students, StudentU applicants are more likely to be female (9.2 pp), Hispanic (10.8 pp), gifted (5.9 pp), and enrolled in charter school (4.7 pp). They are less likely to be black (9.3 pp), white (3.4 pp), and FRL-eligible (15.0 pp) They are also slightly younger when starting fifth grade (0.087 years, or around one month), which represents the combination of fewer repeated

[6]For a more detailed examination of differences between the traditional public and charter sectors in the state of North Carolina, see Ladd et al. (2016).

grades prior to fifth grade and less academic redshirting. They also have higher baseline test scores in math and reading (0.31 and 0.26 standard deviations, respectively) than the population of FRL-eligible students as a whole.

3.4 Covariate Balance Tests, StudentU Lottery Winners versus Losers

Table 2 presents the results from covariate balance tests designed to compare StudentU lottery winners and losers in the pooled sample of 2012, 2013, and 2014 cohorts. Columns (1) and (2) report summary statistics to describe the StudentU lottery winners and lottery losers, respectively, while Column (3) presents the difference in means between the lottery winners and lottery losers, conditional on lottery fixed-effects and lottery fixed-effects interacted with gender. Column (4) reports the p-value for the statistical significance test of the difference in means.

Since lottery offers were allocated randomly within gender subgroups, there should not be any significant or meaningful differences between the StudentU lottery winners and lottery losers, conditional on lottery fixed-effects and lottery-fixed effects interacted with gender. Indeed, this is the case, with the exception of baseline (5th grade) FRL-eligibility. Lottery winners are more likely than lottery losers to be FRL-eligible, resulting in a 12.7 percentage point gap between the two groups. This difference is meaningful and statistically significant at the five percent level. I find no other statistically significant differences between the lottery winners and lottery losers and note that a single significant difference is consistent with chance. I cannot reject the null hypothesis (F-test) that the covariates are jointly zero as predictors of treatment status. As a precaution, I control for baseline FRL eligibility in all subsequent analysis, in order to account for any ways in which this characteristic may have influenced student outcomes. To the extent that this measured imbalance affects my estimates, however, it is likely to bias treatment estimates toward zero, since the treatment group is more disadvantaged than the control group at baseline.

4 Empirical Strategy

To estimate the effect of a StudentU lottery offer and StudentU enrollment on student outcomes in early high school, I implement a two-stage least-squares (2SLS) approach that exploits the program's lottery-based admissions system. Using student-level information on lottery offers combined with information on program take-up, I obtain both Intent-to-Treat (ITT) and Treatment-on-the-Treated (TOT) estimates that capture the effects of lottery offers and enrollment, respectively. Below I present my estimating equations, discuss key threats to validity, and report first-stage results.

4.1 Estimating Equations

To estimate the reduced-form effect of a StudentU lottery offer on student outcomes, I use an equation of the following form:

$$Y_{ic} = \alpha_0 + \alpha_1 \times SU_{ic} + \sum_j \gamma_j d_{ij} + \sum_j \gamma_j d_{ij} \times Female_i + \Gamma' X_{ic} + \varepsilon_{ic} \tag{1}$$

In Equation (1), Y_{ic} is an outcome (e.g., the number of course credits earned by the end of ninth grade) for student i in cohort c. SU_{ic} is a binary variable equal to one if student i won the lottery in cohort c. d_{ij} are cohort-specific dummies, which are included on their own and interacted with gender ($j = 2012, 2013, 2014$). The interacted dummies account for the fact that StudentU conducted annual admissions lotteries separately for male and female students. X_{ic} is a vector of student-level covariates obtained at baseline, including: gender, race/ethnicity (Black, Hispanic, other), charter enrollment, FRL-eligibility, age in the fall semester of 5th grade, gifted designation, special education placement, and Limited English Proficiency (LEP) status. All baseline covariates were measured during the student's 5th grade school year, prior to the time when the student learned about whether he or she had received a StudentU lottery offer. The error term, ε_{ic}, is assumed to be uncorrelated with all other determinants of the outcome and captures random fluctuations in student-level

outcomes.

To estimate the effect of StudentU enrollment on student outcomes, I implement a 2SLS approach using the following two equations:

$$Enroll_{ic} = \kappa_0 + \kappa_1 \times SU_{ic} + \sum_j \gamma_j d_{ij} + \sum_j \gamma_j d_{ij} \times Female_i + \Theta' X_{ic} + \nu_{ic} \tag{2}$$

$$Y_{ic} = \beta_0 + \beta_1 \times \hat{Enroll}_{ic} + \sum_j \gamma_j d_{ij} + \sum_j \gamma_j d_{ij} \times Female_i + \Delta' X_{ic} + \eta_{ic} \tag{3}$$

Equation (2) captures the effect of a lottery offer, SU_{ic}, on enrollment in StudentU, $Enroll_{ic}$, for student i in cohort c, conditional on the same covariates, cohort dummies, and cohort dummies interacted with gender as in Equation (1). From this first-stage equation I obtained predicted values of the binary enrollment indicator, $\hat{Enroll}_{ic}$, and included these on the right-hand side in the second stage, which is summarized by Equation (3). Second-stage estimates of β_1 can be interpreted as the average effect of enrollment in StudentU on student outcomes among the compliers (i.e., those students induced to enroll in StudentU by the lottery offer). This effect is equal to the ratio of α_1, the effect of receiving a lottery offer on student outcomes (numerator), to κ_1, the effect of receiving a lottery offer on the likelihood of enrollment in StudentU (denominator).

4.2 Threats to Validity

The main threat to the internal validity of my estimates comes from the issue of missing outcome data, particularly if rates of missing-ness differ between lottery winners and lottery losers. In this paper, missing outcome data is likely the result of (1) moving out of the state of North Carolina or (2) transferring to a private/independent school that does not report information to the North Carolina Department of Public Instruction (DPI). Thus, differential missing-ness by lottery group is not the result of attrition from StudentU or from Durham County. Unlike many other settings, outcome data is still observed for students

who transfer to other public or charter schools in the state of North Carolina.

In Appendix Table A2 I report the results from several regressions designed to investigate whether rates of missing outcome data differ between lottery winners and lottery losers. In these regressions, I regress a binary variable for missing outcome data (missing number of credits earned, grade point average, or suspension outcomes) on a binary variable for lottery status, conditional on cohort dummies and cohort dummies interacted with gender. Column (1) of Panel(A) presents estimation results from this regression, which captures differences in rates of missing outcome data by lottery group. StudentU lottery winners are around 7.7 percentage points less likely to have missing outcome data than their lottery loser counterparts. Columns (2) and (3) report results from specifications that are augmented with student-level demographics and controls for baseline achievement. The point estimates are nearly identical to those without controls. For completeness, Panels (B)-(D) report estimates from the same specifications separately by lottery group. Differential rates of missing data are most severe in the 2013 cohort, followed by the 2014 and 2012 cohorts, respectively.

To address the potential bias induced by differentially missing outcome data, I augment presentation of the main results with results from three standard methods for dealing with missing outcome data: mean imputation, inverse probability weighting (IPW), and multiple imputation. Reassuringly, the results are qualitatively unchanged when using these methods, which I present for completeness in Online Appendix C.

4.3 First-Stage Results

Table A3 reports first-stage estimation results from Equation (2). The results in Column (1) indicate that StudentU lottery winners were around 85.7 percentage points more likely to enroll in StudentU than lottery losers. The results in Columns (2) and (3) demonstrate that addition of student-level demographic covariates and baseline test scores have minimal effects on the magnitude of this point estimate, as is expected if lottery winners and losers are balanced on observables at baseline. Columns (6) and (7) present results separately by

baseline achievement test scores.[7] Low-achieving lottery winners are slightly more likely to take up the offer of enrollment than high achieving lottery winners (88.0 percent take-up versus 86.6 percent take-up).

5 Main Results

5.1 The Effect of StudentU on Credits Earned in Early High School

Panel (A) of Table 3 presents ITT estimates representing the effect of a lottery offer on the number of credits earned by the end of ninth grade. The point estimate in Column (3) indicates that lottery winners accumulated around 0.45 more course credits than lottery losers by the end of ninth grade. This translates into a 6 percent increase relative to the control group mean of 7.04 credits. This point estimate is nearly identical to the point estimates presented in Columns (1) and (2), which come from specifications that exclude baseline student covariates and test scores, respectively. Panel (B) presents TOT results for the same credit accumulation outcome. The TOT estimate represents the effect of enrolling in StudentU on credits earned in ninth grade among the compliers. Due to high take-up rates, the TOT results are very similar to the ITT estimates.

To investigate treatment heterogeneity on the basis of prior achievement, I next present results from a specification in which lottery status is interacted with an index of baseline student achievement. This index of baseline achievement is an average of each student's standardized math and reading test scores from 5th grade. I divided the sample into two groups: low and high baseline achievement, respectively, based on the sample median (-0.26 SDs). Students in the high baseline achievement group have an average index score of 0.38 SDs (median = 0.26 SDs), while students in the low baseline achievement group have an average index score of -0.90 SDs (median = -0.80 SDs).

[7] I construct an index of baseline achievement by taking the mean of the student's 5th grade math and reading test scores. Subject-specific test scores are expressed in standard deviation units (normalized relative to the statewide mean and standard deviation by grade, subject, and year.)

Columns (4) and (5) present results from the interacted model and reveal clear evidence of heterogeneous treatment effects. The point estimate for lottery winners with low baseline achievement is 0.822 credits and is statistically significant at the 0.05-level, while the point estimate for lottery winners with high baseline achievement is 0.082 credits and is statistically indistinguishable from zero. Column (5) reports the p-value from a statistical test of the difference in these two coefficients, which allows me to reject the null hypothesis of equality ($p = 0.003$). Once again Panel (B) presents TOT estimates that are qualitatively very similar to the ITT estimates.

5.2 The Effect of StudentU on Grade Point Average in Early High School

Panel (A) of Table 4 presents ITT estimates representing the effect of a lottery offer on student grade point average at the end of ninth grade. The point estimates for the full sample in Columns (1)-(3) are small in magnitude and statistically insignificant. Columns (4) and (5) present results from a specification in which lottery status is interacted with an index of baseline student achievement and once again reveal evidence of significant treatment heterogeneity. The point estimate for lottery winners with low baseline achievement is 0.370 weighted grade points and is statistically significant at the 0.05-level. In contrast, the point estimate for lottery winners with high baseline achievement is small, slightly negative, and statistically indistinguishable from zero. The p-value from a statistical test of the difference in these two coefficients in Column (5) is 0.027, which allows me to once again reject the null hypothesis of equality. Panel (B) presents TOT estimates, which are again qualitatively similar.

5.3 The Effect of StudentU on the Probability of Suspension in Early High School

Panel (A) of Table 5 presents estimates of the effect of a lottery offer on the probability of suspension during ninth grade. The point estimate for the full sample in Column (3) indicates

that lottery winners were around 10.3 percentage points less likely to be suspended during ninth grade than their lottery loser counterparts. In relative terms, this translates into a 47 percent reduction (control mean is 23.7). The point estimates in Columns (4) and (5) reveal significant evidence of treatment effect heterogeneity on the basis of baseline achievement. The point estimate in Column (4) reports a statistically significant 17.1 percentage point reduction in the likelihood of suspension in ninth grade among lottery winners with low baseline achievement. In contrast, Column (4) reports a 3.6 percentage point reduction that is statistically insignificant. The p-value from a statistical test of the null hypothesis of equality is 0.092 (marginally significant). The results from the interacted model once again provide strong evidence to suggest that the mean impact in the full sample of lottery winners is driven by effects on the subgroup of students with low baseline achievement.

5.4 Discussion of Main Results

I find substantial evidence to suggest that the effects of StudentU were concentrated among lottery winners who entered the program with low baseline achievement, as measured by fifth grade math and reading test scores. By the end of ninth grade, these students, who entered the program with average fifth grade math and reading test scores nearly one standard deviation below the statewide mean (mean = -0.90 SDs and median = -0.80 SDs among this subgroup), more closely resembled – and in some cases had better outcomes than – their control group (lottery loser) counterparts who entered the program with high baseline achievement. In the cases of credits earned and reduced probability of suspension, lottery winners with low baseline achievement had average outcomes that exceeded the average outcomes of their control group counterparts who entered the program with high baseline achievement. In the case of grade point average, the reduced-form treatment effect was large enough to close around 35 percent of the gap between low baseline and high baseline achievers in the control group.

In contrast to Oreopoulos et al. (2017), who report that the effects of the Pathways

program are largest among students with high baseline achievement, this paper is the first in the literature on comprehensive services to document such substantial and consistent evidence of effects concentrated among low-achieving students. Heterogeneous treatment effects by prior achievement are not reported in Rodríguez-Planas (2012), although she does report significant evidence of heterogeneous treatment effects by gender.

Taken together with previous work, these findings suggest that comprehensive services delivered outside of the regular school day may be most effective at improving educational outcomes among students with low levels of academic achievement at baseline. Extra time outside of school in a small-group and structured setting may improve study skills, provide students with the support needed to keep up with regular assignments and homework, and offer opportunities to ask questions about assigned work. These findings are consistent with results reported in Kraft (2015), who finds that low-achieving students benefit more than high-achieving students from small-group tutorials that offer individualized and differentiated instruction outside of the regular school day. The findings are also consistent with experimental evidence from Schueler (2018), who finds that small-group academic instruction – even in small weeklong doses – provided by a single teacher led to less exclusionary discipline, even though students' test scores did not increase.

6 Mechanisms

To gain insight into the mechanisms underlying increased credit accumulation, higher grade point averages, and reduced likelihood of suspension among lottery winners with low baseline achievement, I investigated several intervening variables that provide insight into the causal channels through which StudentU affects student outcomes. To distinguish between channels of student effort, achievement (cognitive skills), and behavior, I re-estimated the same models for several intervening variables that serve as proxies for these channels.

Table 6 presents ITT estimates representing the effect of a lottery offer on credits attempted in ninth grade and a binary variable indicating whether the student failed any

courses during ninth grade. The point estimates in Panel (A) do not reveal and statistically significant effects on credits attempted, although the point estimates in Panel (B) do reveal substantial reductions in the likelihood of any course failure. The point estimate in Column (3) indicates that lottery winners in the full sample are around 8.6 percentage points less likely to fail any courses relative to their lottery loser counterparts. The point estimates in Columns (4) and (5) make clear that this effect is entirely driven by lottery winners with low baseline achievement, who are 20.4 percentage points less likely to fail any courses during ninth grade. This contrasts with the small and statistically insignificant point estimate among lottery winners with high baseline achievement. The p-value from a statistical test of the difference between these coefficients is $p = 0.008$, which means that I can reject the null hypothesis of equality. For completeness, I present TOT estimates for the same outcomes in Appendix Table A4. These results are qualitatively similar to the reduced-form effects.

I do not find any evidence to suggest that improvements in cognitive skills are a likely mechanism through which lottery winners improve their early high school outcomes. Table 7 presents ITT estimates of the effect of winning the lottery on math and reading test scores in eighth grade.[8] For completeness, I present TOT estimates for the same outcomes in Appendix Table A5.

Table 8 presents ITT estimates representing the effect of a lottery offer on the likelihood of a violent/weapons-related and other disciplinary infractions in ninth grade. Although I do not find any evidence of reductions in the likelihood of violent/weapons-related infractions, I find substantial evidence of reductions in the likelihood of other disciplinary infractions in Panel (B). The point estimates in Column (4) indicate that lottery winners in the full sample are around 10.3 percentage points less likely to have a reported other infraction in ninth grade. The point estimates in Columns (4) and (5) reveal that this main effect is likely driven by lottery winners with low baseline achievement. The point estimate for lottery winners with low baseline achievement is 16.1 percentage points and statistically

[8]There are no achievement test scores available in ninth grade.

significant, while the point estimate for lottery winners with high baseline achievement is 4.6 percentage points and statistically indistinguishable from zero, although I cannot reject the null hypothesis of equality ($p = 0.146$).

Taken together, the results suggest that StudentU improved student effort and behavior in school among lottery winners with low baseline achievement. I find no evidence of any improvements in student achievement. This is consistent with previous literature on the effects of tutoring outside of the regular school day (Heinrich et al., 2010; Zimmer et al., 2010; Heinrich et al., 2014). It contrasts with work that reports results from one-on-one or two-on-one, high-dosage tutoring that occurs within the context of the regular school day (Ander et al., 2016).

7 Predicted Effect on High School Graduation and Program Costs

To assess the likely effects of improved early high school outcomes on high school graduation, I constructed an index based on students' early high school outcomes and estimated the empirical relationship between this index and the likelihood of subsequent high school graduation. The binary index – henceforth, the Early High School Outcomes Index – was equal to one if at the end of ninth grade a student (1) had earned the minimum number of credits required to transition to tenth grade and (2) had not received any suspensions. The Early High School Outcomes Index was equal to zero otherwise. I then estimated the relationship between the Early High School Outcomes Index and the likelihood that a student graduated from high school within 5 years using data from three successive cohorts of first-time ninth graders in Durham County (this includes students in traditional public and charter schools). Although this relationship was estimated among cohorts of first-time ninth graders in Durham County, the statewide longitudinal data permit me to track high school graduation from any public or charter school in the state of North Carolina.

Panel (a) of Figure 2 plots the empirical relationship between the Early High School Outcomes Index and the likelihood of graduation from high school within five years. A one-

unit change in the Early High School Outcomes Index is associated with a 29 percentage point increase in the likelihood that a student graduates from high school within five years (control mean = 0.59). Although there is some variation across cohorts, the relationship appears to be quite stable.

Panel (b) depicts the effect of winning the StudentU lottery on the likelihood that the Early High School Outcomes Index is equal to one. The pooled estimate indicates that StudentU lottery winners were around 12 percentage points more likely to have an Early High School Outcomes Index equal to one when compared to their lottery loser counterparts (control mean = 0.51). Based on these estimated relationships, I calculate an expected graduation rate of 77 percent for lottery winners and 73 percent for lottery losers, which implies that the effect of winning the lottery on the likelihood of high school graduation is a 4 percentage point increase. This predicted effect on high school graduation is considerably smaller than the actual effect realized in the Pathways program at the original site of implementation (15.3 percentage points), although it is similar in magnitude to the Pathways effect at the expansion site (5.8 percentage points) and to the (statistically insignificant) effect reported for the QOP (3.2 percentage points) (Oreopoulos et al., 2017; Rodríguez-Planas, 2012).

The predicted effect of StudentU on high school graduation is large and meaningful but should not be considered in isolation. When evaluating any educational intervention, it is important to consider not only the effects – and their social value – but also the level of investment required to obtain said impacts. To obtain cost estimates of per student spending for StudentU, I used three years worth of reported expenditure data from StudentU to estimate a cost of $4,790 per student per year. Summing these costs over four years and assuming a real discount rate of 7 percent, I obtained a total cost estimate of $16,225 per student, which represents the total cost per student for four years of StudentU programming and services (this corresponds to the number of years between a student's matriculation into the program and the early high school outcomes observed in this paper). This cost estimate compares favorably to estimates from other comprehensive programs and related programs

in the literature. Oreopoulos et al. (2017) report a per student cost estimate of $13,400 for Pathways and Rodríguez-Planas (2012) reports a per student cost estimate of $25,000 for QOP (4-year program).

8 Conclusion

In this paper I investigate the effects of StudentU, a comprehensive, multi-year program designed to improve educational outcomes among disadvantaged students, on the early high school outcomes of participating students. To do this, I exploit variation induced by offers from oversubscribed admissions lotteries. Although I find some evidence of effects on early high school outcomes among the full sample of lottery winners, more detailed investigation reveals that these were driven exclusively by the subgroup of lottery winners who entered the program with low baseline achievement. I find that lottery winners who entered StudentU with low baseline achievement earned more course credits (0.82 credits), achieved higher grade point averages (0.37 grade points), and were less likely to be suspended (17.1 percentage points) during ninth grade than their lottery loser counterparts.

In an investigation of the mechanisms underlying these effects, I find evidence to suggest that increased student effort and improved behavior in school are the likely channels through which these effects flowed. Using data on credit attempts, course failure, student achievement (in eighth grade), and disciplinary infractions, I find that lottery winners were around 20.4 percentage points less likely to fail a course during ninth grade and around 10.3 percentage points less likely to be reported for a miscellaneous (i.e., not violent and not weapons-related) disciplinary infraction during ninth grade. I do not find any statistically significant evidence of effects on student achievement.

As a means to forecast longer-run impacts on students' high school graduation outcomes, I conclude by presenting the results from a simple prediction exercise designed assess how these improvements in early high school outcomes likely translate into successes later in high school. Using an index of students' early high school outcomes, I predict that lottery winners

are around 4 percentage points more likely to graduate from high school than lottery losers (5 percent effect). These results are squarely in line with estimated effects presented in the previous literature. I also report estimates of per-student program costs, which also compare favorably to estimates reported for similar comprehensive programs. Taken Together, the results from this paper suggest that comprehensive services delivered outside of the regular school day have the potential to improve the educational outcomes of disadvantaged students outside of the regular school day.

Tables and Figures

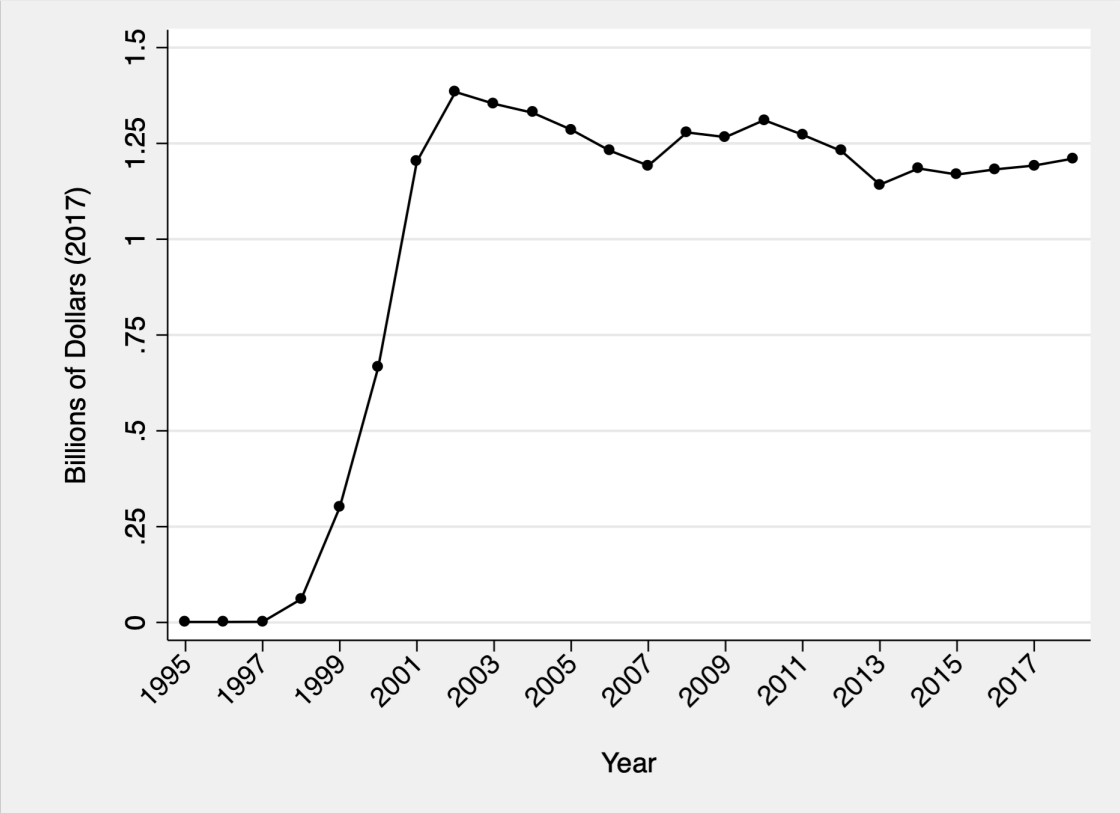
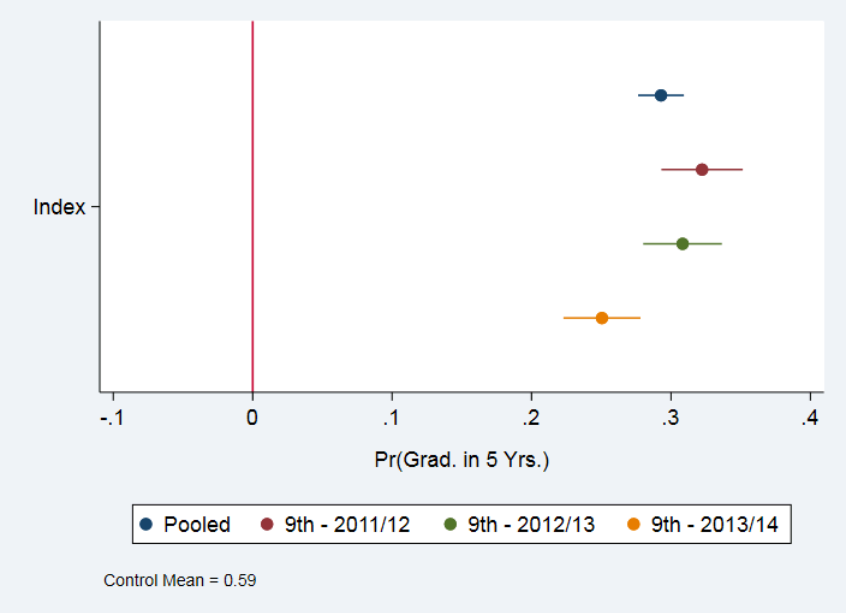
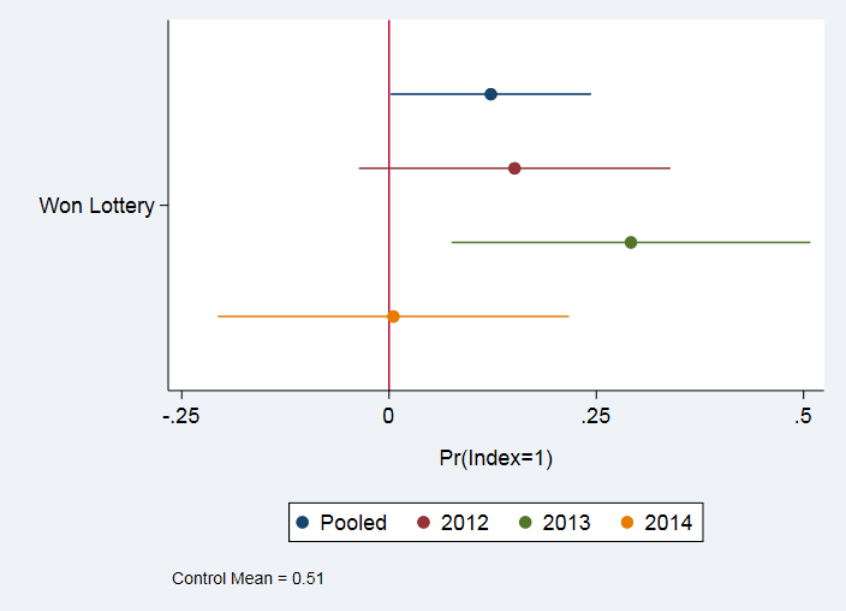


Figure 1: Federal Appropriations for 21st Century Community Learnings Centers in the United States, 1995-2018

Notes: This figure depicts federal appropriations (in 2017 dollars) for the Twenty-First Century Community Learning Center Program, which was authorized by Title I, Part X of the Elementary and Secondary Education Act (ESEA). This program provides funding for schools in the United States to implement activities that provide educational, recreational, cultural, health, and social services outside of the regular school day. For more information, see Stapleton (1998) and McCallion (2001).



(a) Ninth Grade Index and 5-Year High School Graduation



(b) SU Lottery and Ninth Grade Index

Figure 2: Predicted Effect of SU on High School Graduation

Notes: Panel (a) depicts coefficient estimates for the effect of the Early High School Outcomes Index on the likelihood of high school graduation (within 5 years) for three successive cohorts of first-time ninth grade students in Durham County, NC. Panel (b) depicts coefficient estimates for the effect of winning the StudentU lottery on the probability that the Early High School Outcomes Index is equal to one.

Table 1: Descriptive Statistics, 5th Grade Students in Durham County, 2011/2012-2013/14

	(1) Durham	(2) DPS	(3) Charter	(4) Durham FRL	(5) DPS FRL	(6) Charter FRL	(7) StudentU Applicants	(8) Diff.: (7)-(1)	(9) Diff.: (7)-(4)
Female	0.495	0.494	0.496	0.493	0.492	0.505	0.585	0.091***	0.092***
	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.501)	(0.493)	(0.028)	(0.028)
Black	0.500	0.499	0.512	0.578	0.559	0.792	0.485	-0.016	-0.093***
	(0.500)	(0.500)	(0.500)	(0.494)	(0.497)	(0.407)	(0.501)	(0.028)	(0.028)
Hispanic	0.224	0.245	0.078	0.319	0.335	0.137	0.427	0.203***	0.108***
	(0.417)	(0.430)	(0.268)	(0.466)	(0.472)	(0.344)	(0.495)	(0.028)	(0.028)
White	0.211	0.190	0.354	0.059	0.061	0.037	0.024	-0.187***	-0.034***
	(0.408)	(0.392)	(0.478)	(0.235)	(0.239)	(0.189)	(0.154)	(0.010)	(0.009)
Special Ed.	0.173	0.171	0.182	0.189	0.190	0.178	0.150	-0.022	-0.039*
	(0.378)	(0.377)	(0.386)	(0.392)	(0.392)	(0.383)	(0.358)	(0.020)	(0.021)
Gifted	0.237	0.264	0.053	0.149	0.162	0.007	0.209	-0.028	0.059**
	(0.425)	(0.441)	(0.224)	(0.357)	(0.368)	(0.083)	(0.407)	(0.023)	(0.023)
LEP	0.118	0.129	0.037	0.167	0.176	0.065	0.163	0.045**	-0.005
	(0.322)	(0.336)	(0.190)	(0.373)	(0.381)	(0.246)	(0.370)	(0.021)	(0.021)
Age	10.524	10.530	10.484	10.568	10.568	10.569	10.481	-0.043*	-0.087***
	(0.464)	(0.464)	(0.460)	(0.490)	(0.486)	(0.528)	(0.394)	(0.022)	(0.023)
Free/Red. Lunch	0.625	0.659	0.393	1.000	1.000	1.000	0.850	0.225***	-0.150***
	(0.484)	(0.474)	(0.489)	(0.000)	(0.000)	(0.000)	(0.358)	(0.021)	(0.020)
Charter	0.129	0.000	1.000	0.081	0.000	1.000	0.128	-0.001	0.047**
	(0.335)	(0.000)	(0.000)	(0.273)	(0.000)	(0.000)	(0.335)	(0.019)	(0.019)
Math Ach.	-0.224	-0.221	-0.244	-0.521	-0.501	-0.746	-0.208	0.015	0.313***
	(1.042)	(1.048)	(1.005)	(0.927)	(0.930)	(0.866)	(0.865)	(0.049)	(0.050)
Reading Ach.	-0.241	-0.264	-0.090	-0.603	-0.601	-0.626	-0.342	-0.101*	0.261***
	(1.082)	(1.083)	(1.068)	(0.966)	(0.966)	(0.965)	(0.912)	(0.052)	(0.053)
N	8576	7473	1103	5328	4896	432	328		

Notes: Columns (1)-(7) report means and standard deviations (in parentheses) for the variable listed in each row. Column (1) reports descriptive statistics for 5th grade students in Durham, NC (Durham Public Schools and charter schools in Durham County) pooled across the 2011/12-2013/14 school years. Columns (2) and (3) partition 5th grade students in Durham County into students in the Durham Public Schools (DPS) and students enrolled in charter schools in Durham County. Columns (4)-(6) present information for the same three groups as in Columns (1)-(3) but restricted to the subsample of students who were eligible for free- or reduced-price lunch (FRL). Column (7) reports descriptive statistics for StudentU Applicants who applied for admission in the spring semesters of 2012-2014. Column (8) reports the difference in means and associated standard error (in parentheses) between Columns (1) and (7). Column (9) reports the difference in means and associated standard error (in parentheses) between Columns (4) and (7).

Table 2: Covariate Balance Tests

	(1) Lottery Winners	(2) Lottery Losers	(3) Diff.: Winners v. Losers	(4) p-value
Black	0.436	0.510	-0.071	0.274
	(0.499)	(0.501)	(0.065)	
Hispanic	0.511	0.402	0.120	0.063
	(0.503)	(0.492)	(0.065)	
White	0.021	0.026	-0.011	0.560
	(0.145)	(0.159)	(0.019)	
Special Ed.	0.117	0.165	-0.061	0.182
	(0.323)	(0.372)	(0.045)	
Gifted	0.234	0.191	0.035	0.516
	(0.426)	(0.394)	(0.054)	
LEP	0.181	0.165	0.026	0.592
	(0.387)	(0.372)	(0.049)	
Age	10.483	10.520	-0.027	0.630
	(0.361)	(0.540)	(0.057)	
Free/Red. Lunch	0.926	0.799	0.127	0.002
	(0.264)	(0.402)	(0.041)	
Charter	0.117	0.103	-0.002	0.969
	(0.323)	(0.305)	(0.041)	
Math Ach.	-0.120	-0.223	0.092	0.388
	(0.825)	(0.848)	(0.107)	
Reading Ach.	-0.287	-0.383	0.061	0.602
	(0.876)	(0.876)	(0.117)	
p-value (joint F-test)				0.167
Obs.	94	194	288	

Notes: Column (1) reports raw means and standard deviations for StudentU lottery winners who applied for and received a lottery offer in the spring semesters of 2012-2014. Column (2) reports raw means and standard deviations for StudentU lottery losers who applied for but did not receive a lottery offer in the spring semesters of 2012-2014. Column (3) reports the difference in means and associated standard errors (in parentheses) for StudentU lottery winners versus lottery losers, conditional on lottery fixed-effects and lottery fixed-effects interacted with gender. Column (4) reports the p-value associated with a two-tailed t-test of the difference in means reported in Column (3). The sample includes first-time, non-sibling applicants to StudentU in the 2011/12-2013/14 school years.

Table 3: The Effects of StudentU on Credits Earned in Early High School

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	0.463***	0.480***	0.452***	0.822***	0.082	0.003
	(0.159)	(0.160)	(0.161)	(0.209)	(0.191)	
Panel B. TOT						
Enrolled in SU	0.541***	0.558***	0.524***	0.940***	0.096	0.003
	(0.183)	(0.182)	(0.181)	(0.231)	(0.218)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		7.04		6.68	7.45	
Observations		279		143	136	

Notes: The dependent variable is the number of credits earned at the end of ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. First-stage estimates are presented in Appendix Table A3. Robust standard errors are reported in parentheses.

Table 4: The Effects of StudentU on Grade Point Average (GPA) in Early High School

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	0.166	0.176	0.140	0.370***	-0.090	0.027
	(0.141)	(0.128)	(0.120)	(0.142)	(0.171)	
Panel B. TOT						
Enrolled in SU	0.194	0.205	0.162	0.423***	-0.106	0.023
	(0.161)	(0.144)	(0.135)	(0.157)	(0.195)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		2.81		2.31	3.37	
Observations		279		143	136	

Notes: The dependent variable is grade point average at the end of ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. First-stage estimates are presented in Appendix Table A3. Robust standard errors are reported in parentheses.

Table 5: The Effects of StudentU on the Probability of Suspension in Early High School

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	-0.099**	-0.112**	-0.103**	-0.171***	-0.036	0.092
	(0.047)	(0.046)	(0.046)	(0.059)	(0.063)	
Panel B. TOT						
Enrolled in SU	-0.115**	-0.130**	-0.120**	-0.196***	-0.042	0.087
	(0.054)	(0.052)	(0.052)	(0.065)	(0.072)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		.237		.306	.160	
Observations		279		143	136	

Notes: The dependent variable is an indicator that takes on the value of one if the student received at least one suspension in ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. First-stage estimates are presented in Appendix Table A3. Robust standard errors are reported in parentheses.

Table 6: The Effects of StudentU on Student Effort (ITT)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Credits Attempted						
	0.132*	0.130*	0.119	0.167	0.072	0.464
	(0.074)	(0.074)	(0.074)	(0.102)	(0.094)	
Control Mean	7.692	7.692	7.692	7.633	7.759	
Obs.	279	279	279	136	143	
Panel B. Course Failure (0/1)						
	-0.081	-0.096*	-0.086*	-0.204***	0.031	0.008
	(0.053)	(0.052)	(0.051)	(0.069)	(0.065)	
Control Mean	0.265	0.265	0.265	0.398	0.115	
Obs.	279	279	279	136	143	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	

Notes: The dependent variable in Panel (A) is the number of credits attempted during ninth grade, and the dependent variable in Panel (B) is an indicator that takes on the value of one if the student received at least one failing course grade during ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Robust standard errors are reported in parentheses.

Table 7: The Effects of StudentU on Student Achievement (8th Grade Test Scores) (ITT)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Math Achievement						
	0.029	-0.010	-0.043	0.071	-0.154	0.147
	(0.124)	(0.105)	(0.089)	(0.114)	(0.121)	
Control Mean	-0.199	-0.199	-0.199	-0.672	0.329	
Obs.	275	275	275	135	140	
Panel B. Reading Achievement						
	0.104	0.063	0.018	0.103	-0.065	0.187
	(0.115)	(0.096)	(0.079)	(0.105)	(0.097)	
Control Mean	-0.205	-0.205	-0.205	-0.673	0.319	
Obs.	275	275	275	135	140	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	

Notes: The dependent variable in Panel (A) is math achievement in 9th grade (measured in standard deviation units), and the dependent variable in Panel (B) is reading achievement in 9th grade (measured in standard deviation units). The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Robust standard errors are reported in parentheses.

Table 8: The Effects of StudentU on Student Behavior (ITT)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Violent/Weapons Infractions						
	-0.038	-0.036	-0.032	-0.021	-0.042	0.692
	(0.034)	(0.034)	(0.035)	(0.047)	(0.040)	
Control Mean	0.097	0.097	0.097	0.112	0.080	
Obs.	279	279	279	136	143	
Panel B. Other Infractions						
	-0.100**	-0.113**	-0.103**	-0.161***	-0.046	0.146
	(0.046)	(0.045)	(0.045)	(0.059)	(0.060)	
Control Mean	0.227	0.227	0.227	0.296	0.149	
Obs.	279	279	279	136	143	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	

Notes: The dependent variable in Panel (A) is an indicator that takes on the value of one if the student was reported for at least one violent/weapons-related disciplinary infraction in ninth grade, and the dependent variable in Panel (B) is an indicator that takes on the value of one if the student was reported for at least one other disciplinary infraction in ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Robust standard errors are reported in parentheses.

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Appendix A: Supplemental Results

Table A1: Matching Results, Overall and Separately by Cohort, 2012-2014

	(1) Overall	(2) 2012	(3) 2013	(4) 2014
Panel A. Overall Matching Results				
Total Number of Records	415	148	122	145
Excluding Siblings	376	139	108	129
Total Matches	324	119	101	104
Overall Match Rate	0.86	0.86	0.94	0.81
Panel B. Lottery Winner Matching Results				
Total Number of Lottery Winners	109	45	29	35
Matched Lottery Winners	100	42	27	31
Lottery Winner Match Rate	0.92	0.93	0.93	0.89
Panel C. Lottery Loser Matching Results				
Total Number of Lottery Losers	267	94	79	94
Matched Lottery Losers	224	77	74	73
Lottery Loser Match Rate	0.84	0.82	0.94	0.78

Notes: Column (1) reports matching results for the 2012-2014 cohorts together. Columns (2)-(4) report matching results separately for StudentU cohorts 2012-2014. The total number of records is based on the total number of eligible (i.e., correct grade, complete, satisfied eligibility criteria), first-time applicants received by StudentU. Matching of StudentU records and administrative education data was performed by staff at the North Carolina Education Research Data Center (NCERDC).

Table A2: Missing Outcome Data, Overall and Separately by Cohort, 2012-2014

	(1)	(2)	(3)
Panel A. Full Sample			
	-0.077**	-0.074**	-0.072**
	(0.035)	(0.036)	(0.034)
	324	324	310
Panel B. 2012 Cohort			
	-0.033	-0.014	0.013
	(0.055)	(0.054)	(0.050)
	119	119	111
Panel C. 2013 Cohort			
	-0.138*	-0.138*	-0.133*
	(0.076)	(0.078)	(0.079)
	101	101	100
Panel D. 2014 Cohort			
	-0.078	-0.083	-0.102**
	(0.055)	(0.053)	(0.043)
	104	104	99
Demographic Controls	No	Yes	Yes
Baseline Achievement	No	No	Yes

Notes: The dependent variable is an indicator that takes on the value of one if the student has missing outcome data. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Robust standard errors are reported in parentheses.

Table A3: The Effect of a StudentU Lottery Offer on Enrollment

	All Students			Baseline Achievement	
				Low	High
	(1)	(2)	(3)	(4)	(5)
Lottery Offer	0.857***	0.855***	0.862***	0.880***	0.866***
	(0.037)	(0.037)	(0.035)	(0.048)	(0.049)
F-Statistic	542.295	542.333	603.013	330.728	309.099
Demographic Controls	No	Yes	Yes	Yes	Yes
Baseline Achievement	No	No	Yes	Yes	Yes
Observations		279	143	136	

Notes: The dependent variable is take-up of the StudentU lottery offer (i.e., enrollment in the program). The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Robust standard errors are reported in parentheses.

Table A4: The Effects of StudentU on Student Effort (TOT)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Credits Attempted						
	0.154*	0.151*	0.138*	0.191*	0.084	0.465
	(0.086)	(0.083)	(0.083)	(0.112)	(0.108)	
Control Mean	7.692	7.692	7.692	7.633	7.759	
Obs.	279	279	279	136	143	
Panel B. Course Failure (0/1)						
	-0.094	-0.112*	-0.100*	-0.233***	0.036	0.006
	(0.060)	(0.058)	(0.057)	(0.075)	(0.074)	
Control Mean	0.265	0.265	0.265	0.398	0.115	
Obs.	279	279	279	136	143	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	

Notes: The dependent variable in Panel (A) is the number of credits attempted during ninth grade, and the dependent variable in Panel (B) is an indicator that takes on the value of one if the student received at least one failing course grade during ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. First-stage estimates are presented in Appendix Table A3. Robust standard errors are reported in parentheses.

Table A5: The Effects of StudentU on Student Achievement (8th Grade Test Scores) (TOT)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Math Achievement						
	0.034	-0.012	-0.050	0.081	-0.181	0.137
	(0.142)	(0.119)	(0.101)	(0.127)	(0.141)	
Control Mean	-0.199	-0.199	-0.199	-0.672	0.329	
Obs.	275	275	275	135	140	
Panel B. Reading Achievement						
	0.122	0.074	0.021	0.118	-0.076	0.175
	(0.132)	(0.109)	(0.089)	(0.116)	(0.112)	
Control Mean	-0.205	-0.205	-0.205	-0.673	0.319	
Obs.	275	275	275	135	140	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	

Notes: The dependent variable in Panel (A) is math achievement in 9th grade (measured in standard deviation units), and the dependent variable in Panel (B) is reading achievement in 9th grade (measured in standard deviation units). The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. First-stage estimates are presented in Appendix Table A3. Robust standard errors are reported in parentheses.

Table A6: The Effects of StudentU on Student Behavior (TOT)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Violent/Weapons Infractions						
	-0.044	-0.042	-0.037	-0.024	-0.050	0.665
	(0.039)	(0.038)	(0.039)	(0.052)	(0.045)	
Control Mean	0.097	0.097	0.097	0.112	0.080	
Obs.	279	279	279	136	143	
Panel B. Other Infractions						
	-0.116**	-0.131**	-0.120**	-0.184***	-0.054	0.144
	(0.053)	(0.052)	(0.050)	(0.065)	(0.069)	
Control Mean	0.227	0.227	0.227	0.296	0.149	
Obs.	279	279	279	136	143	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	

Notes: The dependent variable in Panel (A) is an indicator that takes on the value of one if the student was reported for at least one violent/weapons-related disciplinary infraction in ninth grade, and the dependent variable in Panel (B) is an indicator that takes on the value of one if the student was reported for at least one other disciplinary infraction in ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. First-stage estimates are presented in Appendix Table A3. Robust standard errors are reported in parentheses.

Table A7: The Effects of StudentU on the Probability of ISS and OSS in Early High School (ITT)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ISS						
	-0.071**	-0.086**	-0.083**	-0.152***	-0.013	0.034
	(0.035)	(0.037)	(0.036)	(0.045)	(0.052)	
Control Mean	0.141	0.141	0.141	0.184	0.092	
Obs.	279	279	279	136	143	
Panel B. OSS						
	-0.084**	-0.086**	-0.080**	-0.115**	-0.044	0.257
	(0.040)	(0.040)	(0.039)	(0.054)	(0.047)	
Control Mean	0.162	0.162	0.162	0.194	0.126	
Obs.	279	279	279	136	143	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	

Notes: The dependent variable in Panel (A) is an indicator that takes on the value of one if the student an in-school suspension (ISS) in ninth grade, and the dependent variable in Panel (B) is an indicator that takes on the value of one if the student received an out-of-school suspension (OSS) in ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Robust standard errors are reported in parentheses.

Table A8: The Effects of StudentU on the Probability of ISS and OSS in Early High School (TOT)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ISS						
	-0.083**	-0.100**	-0.096**	-0.174***	-0.015	0.033
	(0.041)	(0.042)	(0.041)	(0.051)	(0.060)	
Control Mean	0.141	0.141	0.141	0.184	0.092	
Obs.	279	279	279	136	143	
Panel B. OSS						
	-0.098**	-0.100**	-0.092**	-0.132**	-0.051	0.250
	(0.046)	(0.045)	(0.044)	(0.059)	(0.054)	
Control Mean	0.162	0.162	0.162	0.194	0.126	
Obs.	279	279	279	136	143	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	

Notes: The dependent variable in Panel (A) is an indicator that takes on the value of one if the student an in-school suspension (ISS) in ninth grade, and the dependent variable in Panel (B) is an indicator that takes on the value of one if the student received an out-of-school suspension (OSS) in ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. First-stage estimates are presented in Appendix Table A3. Robust standard errors are reported in parentheses.

Appendix B: Data

Administrative Data from NCERDC

Administrative data on student characteristics and outcomes came from the North Carolina Education Research Center (NCERDC) at the Center for Child & Family Policy at Duke University. For more information about these data, see https://childandfamilypolicy.duke.edu/research/nc-education-data-center/.

Primary Outcomes: Credits Earned, Grade Point Average, and Suspension

Primary outcomes of interest in this study included: credits earned in ninth grade, grade point average in ninth grade, and suspension (0/1) in ninth grade. The first two outcomes, credits earned and grade point average, were constructed by hand using raw transcript data. Credits earned were calculated by summing the total number of credits earned during ninth grade (this differs from credits attempted because students do not earn credits for courses in which they received an F). The following formula was used to compute (weighted) grade point average: Letter grades were assigned grade points as follows: A+/A/A- (4 points), B+/B/B- (3 points), C+/C/C- (2 points), D+/D/D- (1 point), F (0 points). One additional grade point was awarded for Honors courses. Two additional grade points were awarded for Advanced Placement (AP) and International Baccalaureate (IB) courses. Grade points were then weighted by the number of credits assigned to the course, and grade point average was calculated by dividing by the total number of credits attempted.

Information on disciplinary infractions are collected by the North Carolina Department of Public Instruction (NCDPI) and transferred to the North Carolina Education Research Data Center (NCERDC). According to NCERDC, "Records are generated each time when a legally-reportable offense, a short or long term out-of-school suspension (OSS), a referral to an alternative school or program (ALP), or an expulsion occurs during the school year. NCDPI does not require that less serious incidents (such as those resulting in detentions, in-

school-suspensions and the like) be reported unless those incidents involve a legally reportable offense, OSS, referral to an ALP, or expulsion." The suspension variable is a binary indicator that indicates whether the student received either an in-school and out-of-school suspension during the academic year.

Intervening Variables: Credits Attempted, Course Failure, Violent/Weapons Infraction, Other Infraction, and Math and Reading Test Scores

Intervening variables (used to investigate mechanisms) of interest in this paper included: credits attempted in ninth grade, course failure (0/1) in ninth grade, violent/weapons infraction (0/1) in ninth grade, other disciplinary infraction in ninth grade (0/1), and math and reading test scores from 8th grade. Credits attempted in ninth grade were calculated by summing the total number of credits for which the student registered during ninth grade. Course failure is a binary variable that indicates the student received an F letter grade in (at least) one course during ninth grade. In this paper, (1) violent and weapons-related disciplinary infractions and (2) other disciplinary infractions are two mutually exclusive and exhaustive categories that partition the universe of legally-reportable disciplinary infractions that are tracked by the North Carolina Department of Public Instruction. Violent/Weapons-related disciplinary infractions roughly follows the definition employed by Holbein and Ladd (2017) and includes infractions such as assaults, robberies, homicides, bullying, aggressive behavior, and all infractions involving the use of a weapon. I have made every effort to harmonize this category across academic years, even though there are slight revisions to the list of legally reportable infractions each school year.

Annual student-level math and reading achievement test scores come from the statewide program of North Carolina End-of-Grade (EOG) tests. These tests are administered annually to all North Carolina traditional public school and charter school students in grades 3-8. EOG achievement tests, which are aligned with the North Carolina Standard Course of Study, are used to track annual student performance and growth and are used as in-

puts to school accountability. Using data on all traditional public school and charter school students in North Carolina, I normalized EOG scale scores separately by grade, subject, and year, so that the mean is 0 and the standard deviation is 1. For more information about the North Carolina EOG tests, please see http://www.ncpublicschools.org/accountability/testing/eog/.

Student Characteristics

Student characteristics were recorded from a student's 5th grade record. These included: eligibility for free/reduced price lunch, age, special education status, gifted designation, Limited English Proficiency (LEP) status, and math and reading test scores.

Disciplinary Infractions by Category

I partition all reported disciplinary infractions into two categories: Violent/Weapons and Other (includes Sexual, Drug, Disruptive Behavior, and Miscellaneous categories below).

- **Violent/Weapons:** Assault resulting in a serious injury, Assault involving the use of a weapon, Assault on school personnel not resulting in injury, Death by other than natural causes, Robbery without a dangerous weapon, Kidnapping, Communicating threats, Affray, Fighting, Hazing, Aggressive behavior, Assault on student w/o weapon and not resulting in injury, Assault on non-student w/o weapon not resulting in injury, Bullying, Violent assault not resulting in serious injury, Assault - other, Assault on student, Possession of a firearm or powerful explosive, Possession of a weapon (excluding firearms/explosives), Robbery with a dangerous weapon, Unlawfully setting a fire, False fire alarm, Bomb threat, Burning of a school building

- **Sexual Offenses:** Rape, Sexual offense, Sexual assault not involving rape or sexual offense, Taking indecent liberties with a minor, Harassment - sexual, Excessive display of affection, Mutual sexual contact between two students

- **Drug Offenses:** Possession of cocaine, Possession of marijuana, Possession of Ritalin, Possession of other controlled substance, Alcohol possession, Inappropriate items on school property, Possession of tobacco, Sale of controlled substance - cocaine, Sale of controlled substance - marijuana, Sale of controlled substance - Ritalin, Sale of controlled substance - other, Possession of a student's own prescription drug, Possession of another person's prescription drug, Distribution of a prescription drug, Use of controlled substances, Use of alcoholic beverages, Use of narcotics, Possession of chemical or drug paraphernalia, Use of tobacco

- **Disruptive Behavior:** Disorderly conduct, Honor code violation, Truancy, Dress code violation, Inappropriate language/disrespect, Insubordination, Bus misbehavior, Disruptive behavior, Late to class, Gang activity, Misuse of school technology, Excessive tardiness, Being in an unauthorized area, Cutting class, Cell phone use, Disrespect of faculty/staff, Leaving school without permission, Leaving class without permission, Skipping school, Skipping class

- **Miscellaneous Offenses:** Extortion, Harassment - verbal, Gambling, Falsification of information, Theft, Property damage, Other school defined offense, Other, Repeat offender, Use of counterfeit items, Possession of counterfeit items, Discrimination

Appendix C: For Online Publication Only

Table C1: The Effects of StudentU on Credits Earned in Early High School (Mean Imputation)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	0.445***	0.442***	0.435***	0.752***	0.151	0.009
	(0.138)	(0.140)	(0.145)	(0.191)	(0.172)	
Panel B. TOT						
Enrolled in SU	0.519***	0.518***	0.509***	0.864***	0.181	0.008
	(0.158)	(0.160)	(0.165)	(0.212)	(0.199)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		7.05		6.72	7.40	
Observations		310		155	155	

Notes: The dependent variable is the number of credits earned at the end of ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. Robust standard errors are reported in parentheses.

Table C2: The Effects of StudentU on Credits Earned in Early High School (IPW)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	0.467***	0.468***	0.459***	0.824***	0.094	0.004
	(0.160)	(0.157)	(0.158)	(0.209)	(0.189)	
Panel B. TOT						
Enrolled in SU	0.545***	0.546***	0.531***	0.944***	0.109	0.003
	(0.183)	(0.179)	(0.177)	(0.231)	(0.214)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		7.04		6.68	7.45	
Observations		279		143	136	

Notes: The dependent variable is the number of credits earned at the end of ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. Robust standard errors are reported in parentheses.

Table C3: The Effects of StudentU on Credits Earned in Early High School (Multiple Imputation)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	0.397**	0.412***	0.409**	0.781***	0.075	0.006
	(0.160)	(0.157)	(0.161)	(0.203)	(0.201)	
Panel B. TOT						
Enrolled in SU	0.463**	0.484***	0.478***	0.898***	0.091	0.005
	(0.184)	(0.181)	(0.184)	(0.227)	(0.233)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		7.19		6.80	7.54	
Observations		310		155	155	

Notes: The dependent variable is the number of credits earned at the end of ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. Robust standard errors are reported in parentheses.

Table C4: The Effects of StudentU on GPA in Early High School (Mean Imputation)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	0.165	0.130	0.113	0.276**	-0.034	0.113
	(0.126)	(0.115)	(0.112)	(0.137)	(0.157)	
Panel B. TOT						
Enrolled in SU	0.193	0.152	0.132	0.318**	-0.040	0.107
	(0.144)	(0.132)	(0.127)	(0.153)	(0.181)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		2.81		2.37	3.29	
Observations		310		155	155	

Notes: The dependent variable is grade point average at the end of ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. Robust standard errors are reported in parentheses.

Table C5: The Effects of StudentU on GPA in Early High School (IPW)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	0.169	0.153	0.150	0.385***	-0.085	0.022
	(0.141)	(0.127)	(0.120)	(0.144)	(0.166)	
Panel B. TOT						
Enrolled in SU	0.197	0.178	0.173	0.441***	-0.101	0.018
	(0.161)	(0.144)	(0.134)	(0.159)	(0.189)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		2.81		2.31	3.37	
Observations		279		143	136	

Notes: The dependent variable is grade point average at the end of ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. Robust standard errors are reported in parentheses.

Table C6: The Effects of StudentU on GPA in Early High School (Multiple Imputation)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	0.154	0.143	0.125	0.350**	-0.078	0.036
	(0.140)	(0.124)	(0.119)	(0.141)	(0.167)	
Panel B. TOT						
Enrolled in SU	0.179	0.168	0.146	0.402**	-0.091	0.033
	(0.161)	(0.142)	(0.136)	(0.157)	(0.194)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		2.84		2.20	3.40	
Observations		310		155	155	

Notes: The dependent variable is grade point average at the end of ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. Robust standard errors are reported in parentheses.

Table C7: The Effects of StudentU on the Probability of Suspension in Early High School (Mean Imputation)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	-0.097**	-0.103**	-0.104**	-0.169***	-0.045	0.091
	(0.042)	(0.042)	(0.043)	(0.057)	(0.055)	
Panel B. TOT						
Enrolled in SU	-0.113**	-0.121**	-0.121**	-0.194***	-0.054	0.092
	(0.049)	(0.048)	(0.049)	(0.064)	(0.064)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		.247		.317	.171	
Observations		310		155	155	

Notes: The dependent variable is an indicator that takes on the value of one if the student received at least one suspension in ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. Robust standard errors are reported in parentheses.

Table C8: The Effects of StudentU on the Probability of Suspension in Early High School (IPW)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	-0.099**	-0.111**	-0.112**	-0.183***	-0.042	0.077
	(0.047)	(0.045)	(0.046)	(0.059)	(0.062)	
Panel B. TOT						
Enrolled in SU	-0.115**	-0.130**	-0.130**	-0.209***	-0.049	0.072
	(0.054)	(0.052)	(0.051)	(0.065)	(0.070)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		.237		.306	.160	
Observations		279		143	136	

Notes: The dependent variable is an indicator that takes on the value of one if the student received at least one suspension in ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. Robust standard errors are reported in parentheses.

Table C9: The Effects of StudentU on the Probability of Suspension in Early High School (Multiple Imputation)

	All Students			Baseline Achievement		
				Low	High	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. ITT						
Won Lottery	-0.090**	-0.106**	-0.103**	-0.173***	-0.040	0.104
	(0.045)	(0.045)	(0.047)	(0.059)	(0.065)	
Panel B. TOT						
Enrolled in SU	-0.105**	-0.124**	-0.121**	-0.199***	-0.048	0.105
	(0.053)	(0.052)	(0.053)	(0.066)	(0.075)	
Demographic Controls	No	Yes	Yes	Yes	Yes	
Baseline Achievement	No	No	Yes	Yes	Yes	
Control Mean		.227		.352	.150	
Observations		310		155	155	

Notes: The dependent variable is an indicator that takes on the value of one if the student received at least one suspension in ninth grade. The sample is comprised of the 2012-2014 StudentU cohorts (lottery winners and losers). Specifications with demographic controls include female, black, Hispanic, free/reduced lunch in 5th grade, age (at the beginning of 5th grade), charter enrollment in 5th grade, gifted in 5th grade, special education in 5th grade, and Limited English Proficient in 5th grade. Specifications with baseline achievement controls include math achievement in 5th grade and reading achievement in 5th grade. Models estimated on the full sample and by separately baseline achievement include cohort fixed-effects and cohort fixed-effects interacted with student gender. Panel (A) reports ITT estimates, and Panel (B) reports TOT estimates. Robust standard errors are reported in parentheses.